Anatomy & Physiology
Lymphatic System and Immunity

**Bell Work:**
Define the terms using your new books (Pages 335-336):

- Lymphocyte
- Phagocyte
- Pathogen
- Antigen
- Antibodies
• 33) Describe the roles of antigens and antibodies in the blood while explaining the ABO system and Rh classification system. In a lab setting with simulated blood, determine the ABO and Rh with an explanation of results written in a scientific method format.

• 35) Describe in a written, oral, or digital format the structure and function of the lymphatic system, lymphatic vessels, and lymph nodes. Differentiate between the cells of the immune response and other defenses, and explain how they work with antigens, antibodies, and individual immunity to maintain homeostasis in the body.
A&P Objectives

- Students will be able to:
  - Distinguish between antigens and antibodies and describe their roles in the immune system by summarizing a professional journal article.
  - Label and describe the structures and functions of the lymphatic system by creating an outline of the path of lymph from a wound infection in a group lab activity.
Overall Function

- Recycles fluids lost from the cardiovascular system
- Transports pathogens to lymph nodes where they can be destroyed
- Stores and matures some types of white blood cells
- Absorbs glycerol & fatty acids from foods
Structures

Lymph
Lymph nodes
Lymph vessels
Lymph ducts

Tonsils
Spleen
Thymus
LYMPH

- Straw-colored fluid (similar to plasma)
- Composed of H₂O, lymphocytes, some granulocytes, O₂, salts, and urea.
- Carries digested food nutrients, O₂, and hormones from cells (What systems relate?)
- Carries wastes from blood capillaries for excretion
- Since the lymphatic system has no pump, skeletal muscle action squeezes lymph along
- Valves prevent backward flow
LYMPH NODES

- Tiny, oval shaped - vary in size from pinhead to an almond
- Located alone or grouped
- Site for lymphocyte maturation and storage
- Acts as a filter for lymph-screening out harmful substances
- If substance can’t be destroyed, node becomes inflamed
LYMPH VESSELS

- Closely parallel to veins
- Located in almost all tissues and organs that have blood vessels
- Tissue lymph enters small lymph vessels which drain into larger vessels called lymphatics – they flow into one of two large, main lymphatics (ducts).
- How is this flow similar to venous and arterial flow?

lymph-vessels-nodes-vessels-ducts-heart
LYMPH DUCTS

- **RIGHT LYMPHATIC DUCT** drains right chest, arm and neck to right subclavian vein to superior vena cava to heart.
- **THORACIC DUCT** gets lymph from left side of chest, head and neck, abdominal area and lower limbs and empties to the left subclavian vein to superior vena cava to heart.
- Lymph flows only in one direction – from body organs towards the heart like the veins.
Transportation of Lymph

Draw something similar to this in notes.
TONSILS

- Masses of lymphatic tissue that produce lymphocytes and filter bacteria – they get smaller in size as person gets older
- **Adenoids (Pharyngeal)**- tonsils on **upper** part of the throat, posterior to the nasal opening
- **Palatine tonsils**- sides of the throat
- **Lingual tonsils**- base of the tongue

Draw an image similar to the above and label the three pairs of tonsils.
**SPLEEN**

- Sac-like mass of lymphatic tissue
- Upper left abdominal cavity, behind stomach
- Contains lymphocytes and creates monocytes and antibodies
- Filters pathogens from the blood, destroys them
- Stores large amounts of RBCs – contracts during vigorous exercise or loss of blood, to release RBCs
- Destroys or removes old or fragile RBCs

*Is the spleen anterior or posterior to the stomach?*

*What is the splenic flexure?*
THYMUS GLAND

- Upper, anterior thorax, above the heart
- Also considered an endocrine gland
- Matures lymphocytes and makes T-lymphocytes

The thymus is larger in a young person. It decreases in size with age and is replaced with mostly connective tissue. Does something like this affect how the elderly are able to fight infections?
<table>
<thead>
<tr>
<th>CELL TYPE</th>
<th>FUNCTION</th>
<th>INNATE OR ADAPTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutrophils</td>
<td>Phagocytosis early in infection</td>
<td>Innate</td>
</tr>
<tr>
<td>Macrophages</td>
<td>Phagocytosis later in infection, stimulate immune system, antigen displaying cell</td>
<td>Innate but stimulate adaptive immunity</td>
</tr>
<tr>
<td>Basophils and mast cells</td>
<td>Release inflammatory chemicals. Basophils are mobile; mast cells are found in connective tissue</td>
<td>Innate</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>Counteract basophils</td>
<td>Innate</td>
</tr>
<tr>
<td>Dendritic cells</td>
<td>Antigen displaying cells, weakly phagocytic</td>
<td>Innate but stimulate adaptive immunity</td>
</tr>
<tr>
<td>Natural killer cells</td>
<td>Kill cells displaying foreign antigens</td>
<td>Innate</td>
</tr>
<tr>
<td>T cells (lymphocytes)</td>
<td>Kill pathogens directly, regulate immune response, activate other lymphocytes, remember past infections</td>
<td>Adaptive</td>
</tr>
<tr>
<td>B cells (lymphocytes)</td>
<td>Release antibodies to foreign antigens, remember past infections</td>
<td>Adaptive</td>
</tr>
</tbody>
</table>
A&P Activities

- **With your small group:**
  - Create a wound someone on your body.
  - (Draw on, use, tape construction paper).
  - Each of you will choose a different location.
  - Using yarn, trace the lymphatic path and infection would follow and determine which lymph nodes would swell (create these as well).
  - Trace the path of the wound until it empties into either the lymphatic or thoracic duct.
  - Determine which it would empty into based on its location.
  - (Help each other, but be considerate and appropriate in the placement of materials).

- **Individually:**
  - Go to the class website.
  - Read and summarize in two high quality paragraphs the Mayo Clinic article: *Antibiotics: Misuse Puts You At Risk.*
  - Then create FIVE questions from the article. Once you are done switch with a partner and answer each other’s questions.
A&P Bell Work
Lymphatic System Day 2

- What is the difference between an antigen and an antibody?
- How is the Lymphatic System like the Circulatory System?
- What occurs inside the lymph nodes?
- Which duct transports lymph from the lower limbs and abdomen and empties into the left subclavian vein?
- Describe Acquired Passive Immunity.
- Does a vaccine contain antibodies OR dead pathogens?
Objectives

- Review the lymphatic structures through a relay activity.
- Explain individual immunity by creating a graphic organizer and participating in a group research project.
Immunity

- This is the body’s ability to resist bacterial invasion and disease.
- Two General Types
  - Innate
  - Acquired

(Begin making a graphic organizer similar to this in your notes).
INNATE IMMUNITY

What we are born with: inherited and permanent.

Includes:
- Unbroken skin
- Mucus and tears
- Blood phagocytes
- Local inflammation
ACQUIRED IMMUNITY

- Body’s reaction to invaders
- This type breaks down again into two groups:
  - Natural Acquired
  - Artificial Acquired

(Don’t forget to add to your graphic organizer)
NATURAL ACQUIRED (ACTIVE) IMMUNITY

- Result of having had and recovered from a disease.
- For example, a child who had chicken pox will usually not get it again – child’s body has manufactured antibodies.
Antibodies pass from the mother to infant in utero via the placenta.
Antibodies pass from the mother to infant outside of the womb through breastmilk.
What else can be transferred from mother to baby by way of these two methods?
ARTIFICIAL ACQUIRED (ACTIVE) IMMUNITY

- Occurs when vaccinated with dead pathogen
- IMMUNIZATION – artificial resistance to a particular infection by artificial means
- Antigen injected into a person to stimulate production of antibodies

- Is there some debate on whether or not we should vaccinate? Why? What are some common immunizations?
ARTIFICIAL ACQUIRED (PASSIVE) IMMUNITY

- Injected antibodies to protect from a specific disease
- Immediate immunity
- Lasts 3-5 weeks
- Used when someone is exposed to tetanus, infectious hepatitis, a few other STDs
Acquired immunity

Naturally acquired

Active
- Infection; contact with pathogen
  - Person forms antibodies
  - Long-lived immunity

Passive
- Antibodies pass from mother to fetus via placenta, or to infant in breast milk
  - Short-lived immunity

Artificially acquired

Active
- Vaccine; dead or attenuated pathogens
  - Person forms antibodies
  - Long-lived immunity

Passive
- Injection of immune serum
  - Antibodies received
  - Short-lived immunity

Does your graphic organizer look similar to this?
This chart may better explain the differences. Copy this chart in your notes.
Group Activity

- Go to the class website and click on the tab:
- Lymphatic System Possible Activities
- Find Activity Three.
- Follow the link to the website concerning bacterial and viral infections.
- Answer the questions.
- After you answer the questions (write your answers on your own paper) THEN, work with your small group to create a Pathogen Board Game.
Pathogen Board Game

- Design a pathogen board game.
- Use a pair of dice or random number selector to determine how far you move.
- Think of games like “The Game of Life” or “Candyland”
- Create spaces like “Forgot to wash hands, go back three spaces” OR “Got your flu shot, go forward 2 spaces” etc...
- Be creative! Use your notes and research to help you!!!